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BRIDGE CONSTRUCTION IN 1947

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In the current year, railroad bridge builders face tasks of an unprecedented magnitude. It is necessary to construct or reconstruct 500 large and medium bridges on railroads in the war-devastated regions, on new trunk lines now under construction, and on the operating systems now under reconstruction.

While the volume of investment in capital reconstruction of ruined bridges on railroads in 1946 exceeded the investment volume of prewar years by two to three times, the 1947 volume will be increased 1.5 times over that of 1946.

The past year may be described as the year of completion of the reorganization of bridge construction, and of the conclusion of the change-over from temporary reconstruction of bridges to new and permanent construction. This was the year of the organization of Glavmostostroy (Main Administration for Capital Reconstruction and Construction of Railroad Bridges) under the Ministry of Transportation. In Glavmostostroy there are now two bridge trusts, one industrial enterprise, and six regional administrations. Total personnel exceeds 40,000. Glavmostostroy has become the leading organization in bridge construction, charged with construction and reconstruction of the largest bridges.

In the last year Glavmostostroy completed work costing 355 million rubles, of which 277 million rubles were spent on construction of large and medium bridges. Six large new bridges were built, 52 completely rebuilt, and 15 were reconditioned.

Bridge builders make maximum use of what remains of abutment foundations. This work is very laborious, but it requires smaller quantities of new materials. Nevertheless, Glavmostostroy last year poured upward of 105,000 cubic meters of

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concrete and reinforced concrete for abutments and spans. The bridge builders also use the metal of the original girders. Last year, 23,500 tons of metal span sections were erected, despite the fact that only 12,000 tons of girders were received from industrial plants. Thus, more than 11,000 tons of old metal girders were used.

Another aspect of 1946 bridge construction should be noted. The poor supply of timber, stone and other materials from central agencies -- in all not more than 40 percent of the requirements -- forced the diversion of specialized, skilled labor forces into self-provisioning. During the year, Glavmostostroy bridge builders procured 155,000 cubic meters of timber, fulfilling the planned self-supply by 103 percent. They also manufactured 7,400 tons of girders, 2,146 tons of scaffoldings and centers, procured 109,000 cubic meters of stone, 172,000 cubic meters of crushed rock, made 400 tons of forgings, etc. All this, in spite of appreciably assisting the fulfillment of the plan, may not be looked upon as normal. Bridge builders should be occupied with their own affairs -- putting supplied materials into construction, erecting spans provided by the central supply agencies.

Many valuable techniques were carried over into capital reconstruction of bridges from the wide experience with temporary re-establishment of destroyed bridges during the war, when the engineers, working at high speed, assured the reconstruction of bridges behind the advancing Soviet Army.

This was especially true in the erection of bridge spans. Before the war, as a rule, they were put together on solid staging. This entailed great expenditure of materials and working force on staging construction. In 1946, such a method was used only occasionally. Erection was accomplished by hinged (navesnyy) or semihinged (polunavesnyy) assembly, by longitudinal or transverse launching, and also with the use of stock metal staging.

Especially economical and effective was the method of longitudinal launching of spans, assembled on the bank and pushed on the longitudinal girders of the assembled span along the axis of the existing temporary bridge. In this method, the need for subfloor staging is almost completely eliminated.

In place of the cumbrous piles and steam rams or hammers used before the war, light pile drivers with Diesel-driven rams weighing 1,200 kilograms are widely employed in basic reconstruction to drive piles under temporary staging.

Cantilever cranes with a 60-ton load capacity, designed and produced during the war, were also effectively employed for lowering small span structures into place. Cranes of large load capacity are now being designed and manufactured for this purpose.

Pneumatic hydraulic jacks, especially useful during the war for temporary bridge reconstruction, are now being widely used in basic reconstruction. This type of jack was not used in bridge construction before the war. In comparison with the hydraulic jacks then used, the effectiveness of the pneumatic hydraulic jacks in raising and lowering span sections is two to three times higher. They are also more reliable and appreciably lighter.

Thus, engineering and technical thought in 1946 was concentrated on improvement of erection of metal span sections. It is known, however, that construction and reconstruction of foundations are among the most labor-consuming operations in bridge building. Work on foundation reconstruction in 1946 was conducted by old, prewar methods, and builders and designers introduced nothing new in this fundamental aspect of bridge construction. In 1947, for reconstruction of destroyed underwater foundations, massive caissons must give way to lighter caissons. Bulkheads of the type designed by engineers Ozerov and

Zabrodin, and metal channel bars of simplified "U" and "I" profile must be more widely used.

A few original and clever solutions to problems of capital reconstruction of destroyed bridges may be enumerated. The reconstruction of the bridge across the Don at Liski is an example. Double-track span sections, 120 meters long and weighing more than 1,000 tons each, were raised a height of 24 meters. Fitting of new metal at the broken ends of the span sections was accomplished with guy derricks, mounted on the piers of the bridge.

Also interesting is the reconstruction of a bridge across the Samara where five span sections, each 55 meters long, were set up on the banks, assembled and then launched longitudinally onto the foundations.

For reconstruction of a bridge across the Dnepr, lifting cranes of the simplest type were designed and built in the vicinity of the bridge from the metal of the collapsed structures. Twelve such cranes were set up for use in the reconstruction of this bridge. Using these cranes, the builders achieved a remarkable increase in speed, and improvement in quality of work.

The construction of a 55-meter span of the bridge across the Sheksna should be noted. Each half of the span was assembled and riveted on its own side of the river. A center pier was built and the riveted half-spans were lowered into place by a cantilever crane and riveted together.

A number of organizational and technical deficiencies in bridge construction in 1946 should be noted. The construction of the bridge across the Moskva-Saleshchikha Station, assigned to the Stal'most Trust, may be pointed out as an example of bad organizational work. Lack of preparatory work extended the estimated 80 days of work to 153 days.

In the course of work on the bridge across the Ingulets, a metal pile already driven had to be replaced by a caisson foundation because of unsound plans drawn up by the Dneprotransproyekt. Apart from a 2-month delay, this entailed a waste of labor and increased the construction cost.

On the bridge across the Plyussa, a portion of the fresh concrete in an abutment of the bridge was badly poured and froze as a result of lack of preparation for concrete work under winter conditions. This pouring had to be broken and removed, and replaced with concrete poured under normal temperature conditions.

In discussing the fundamental problems concerned in the plan for bridge building in 1947 and projects designated for completion in the period 1947-1950, the tasks of planning organizations should be examined first of all.

Beside having to issue technical plans to builders in good time, the planning organizations must make these plans faultless, so that the construction and reconstruction of bridges be completed in the shortest possible time.

A struggle against unnecessary items should be one of the main objectives in the total plan for reducing construction costs and expenditure of material means.

Meanwhile, Soyuztransproyekt (All-Union Planning and Survey Association of the Ministry of Transportation) planning organizations often ignore this most important consideration. As a single example, one may point to the plans of the bridge across the Dnepr at Zhlobin. The plan of reconstruction anticipated an increase of 1.34 meters in the vertical clearance under the bridge with a corresponding heightening of the approaches. This necessitated pouring 85,000

cubic meters of concrete on each of the approaches and increasing the height of the concrete abutments. The total cost of this supplementary work was given as 1.5 million rubles.

Also, this addition to the old, deteriorated fills would lower the general stability of the abutments. Glavmostostroy pointed out to Soyuztransproyekt the illogicalness of this part of the project, and the necessity of its exclusion. Soyuztransproyekt, however, in the person of Pisetsky, chief of the technical section, refused to review the plan, justifying it ostensibly as a categorical demand of the Ministry of the River Fleet. As subsequently developed, the Ministry had insisted on no such thing and gave its consent to the Glavmostostroy for the elimination of this superfluous work.

During a review of projects planned for 1947, Glavmostostroy, in connection with the Bureau of Estimates, Ministry of Transportation, discovered and eliminated unnecessary costs in the projects totaling about 8 million rubles.

In 1946, several construction organizations had to stop work as a result of poor plans, exposed in the course of construction. The bridges on the Chernyy Tashlyk and Ingulets rivers had to be completely redesigned.

The most serious deficiency in the work of the planners is the fact that their planning only amounts to applying accepted, conventional types of design for foundations and spans to a specific situation. Soyuztransproyekt engineers rarely show any engineering creativeness in the search for new and better construction methods. It is not accidental that the standard metal pattern structures planned by Transmostproyekt were rejected by the Scientific Estimates Council of the Gosplan as obsolete and incapable of manufacture by mass production. As a result, a large amount of planning work, costing about half a million rubles went to waste.

The nature of the work of capital reconstruction of bridges is markedly different from ordinary new bridge construction. It is natural, therefore, that the personnel and equipment of a reconstruction organization should differ from those of a construction organization of the prewar period. Inasmuch as each bridge is damaged in a different manner and to a different degree, the demand for qualified workers in various skills is also different for each bridge. As a result, a construction organization starting on a new project is always faced with a shortage of workers in one skill and a surplus of workers in another. For example, on a bridge with destroyed span sections but little-touched foundations, the construction crew always has a shortage of erectors, assemblers, and sometimes even carpenters, but a surplus of cement men. In the event of heavy destruction of the foundations, the situation is reversed.

Such a problem cannot be pushed into the background. It would not arise if each worker possessed several skills. The majority of the skilled workers should know the erector trade. Unfortunately, many supervisors have not given sufficient attention to the introduction of this important measure.

During capital reconstruction, the builders usually encounter damage or only partly destroyed abutment substructures. The abovewater parts of the abutments and the spans are usually completely destroyed. The volume of concrete pouring required is small as compared with new construction. In addition, there is often considerable work of a light nature at separated points along the bridge. Naturally, such a situation requires the use of light and more movable equipment. Therefore, cranes, hoists and other construction equipment and accessories should have lightweight parts, and be easy to assemble and disassemble. The Diesel pile driver, manufactured during the war and widely used now in capital reconstruction, is a good example of this sort of equipment.

The degree to which lifting cranes, movable and stationary, are used in bridge construction establishes the technical level of a given operation. At present, the Glavmostostroy is not distributing a sufficient number of cranes to its organizations.

The planned issue of cranes for 1947 is also very limited. Therefore, the rigid guy cranes or tower cranes must still be used. They may be manufactured both in plants and construction bases, and also on the immediate site.

Labor-consuming loading and unloading work should be performed with cranes. This considerably reduces the labor requirements and speeds up handling.

Mechanization of construction is important for the most rapid solution of the bridge problem. However, the Glavmostostroy equipment park cannot be considered satisfactory.

Last year, earthwork in bridge construction was 80 percent mechanized, preparation and pouring of concrete 90 percent, horizontal materials handling 87 percent, and vertical materials handling 68 percent. The task in 1947 is to mechanize completely concrete and erection work, and therefore it is necessary to augment mechanical and power-driven equipment. This may be done in three ways: (1) by continuing the expansion of machine construction, (2) by a better and more complete use of machines, and (3) by a corresponding reduction of manpower in the work mechanized, especially in labor-consuming activities.

The construction organizations cannot be praised for their use of machinery. Compressor capacity was employed last year only 57 percent, automatic machines 51 percent, cranes 32 percent, conveyers 61 percent, cement mixers 23 percent, and electric-power stations 70 percent. This is one of the reasons for the organizations' failure to fulfill the 1946 plan.

Sixty-ton cantilever cranes, widely used during the war, are employed in reconstruction only for the dismantling of temporary bridges or for dropping in small span sections up to 33 meters long (in the latter case, by separate blocks /sic/). Glavmostostroy is currently finishing plans for a two-cantilever crane of 175-ton capacity. Such a high-capacity crane permits placing whole 55-meter metal span sections on the abutments without the construction of staging, and also the placing of prefabricated reinforced concrete structures of up to 175 tons in weight.

Handling of materials occupies a large place in labor consumption and expenditure of time. On some bridges, the expenditure of labor in horizontal and vertical handling amounts to about 40 percent of the total work on the bridge. However, this aspect of construction mechanization has not, as a rule, been given due attention.

In spite of existing cable cranes, lifting cranes, stationary conveyers and other heavy equipment, manual handling of loads with wheelbarrows and lorries along poorly laid-out paths still predominates. Giving due attention to use of heavy equipment in basic work, the builders forget about small-scale mechanization which may be successfully used in subsidiary work. The utilization of small, movable cranes, overhead trolleys, jacks, and other light equipment is very effective.

Rapid temporary-bridge reconstruction during the war was in many instances achieved by means of prefabrication of large units such as elements of abutments and span sections, placed later with cranes.

Such a method should be widely used in capital reconstruction. Bridges across the bottom land (poyma) of the Don will be rebuilt on this basis in the current year. Here, 76 reinforced concrete arch spans 20 meters long and

weighing more than 60 tons each will be constructed at the side of the bridge, and lowered into place by cantilever cranes of 70-ton capacity.

For reconstruction of bridges up to 15 meters in length, plans have been worked out for single-piece reinforced concrete structures up to 60 tons, to be put in place by cantilever or locomotive cranes. These structures will be manufactured by factory methods.

The construction of deep abutment foundations by use of caissons, although considered one of the most scientifically proved methods, necessarily involves the danger of working in a medium of compressed air, and is most expensive. Even before the war, bridge builders were considering the possibility of completely eliminating the necessity of having workers under compressed air during the sinking of the caisson, or at the very least, of reducing the required number of sand hogs to a minimum, and thus lowering labor costs.

The first steps in this direction were taken in the construction of the Kamennyy and Krasnokholmskiy bridges in Moscow in 1936-1937, where hydromechanization of operations in the chamber of the caisson was first employed. Despite lack of experience with this method, high economy and technical efficiency were established, although some need for refinements in the hydromechanical equipment was also revealed.

Hydromechanical caisson work was widely used in 1939-1940 in the construction of the motor-highway bridge across the Dnepr at Kiev. Pump dredges used on the Moscow bridges for removing earth from the caisson chambers were in this instance replaced by hydroelevators. On the Dnepr bridge construction, 25 caissons were sunk 29 meters into the bottom by means of hydromechanization, and of these, one was dropped automatically, i.e., without workers being present in the caisson. The number of persons working in compressed air was reduced six to eight times in comparison with the usually accepted mode of work. The productivity of the sand hogs was raised ten to twelve times. The speed of caisson work was increased on the average three to four times.

Glavmostostroy has set itself the task of introducing this advanced technology in all instances where it is expedient and technically possible. At present, hydromechanization of caisson operations is being used in the construction of the bridge across the Dnepr at Darnitsa, where 15 caissons will be sunk by this method.

The employment of hydromechanization in bridge construction should not be restricted to caisson work. Hydromechanization has been and should be further used in digging out foundation pits, in pouring approaches to a bridge, in procuring gravel for concrete from the river bottom, etc.

In 1947, bridge builders must widen the use of automatic arc welding on metal span sections. This much has already been done in this respect: (1) Technical specifications for planning and plant manufacture of welded span sections have been established. (2) A group of engineers of the Electric Arc Welding Institute of the Ukrainian Academy of Sciences has been designated to teach the technology of automatic arc welding. (3) An experimental 55-meter welded span section has been set up in the bridge across the Dnepr, upon which regular observations will be conducted. However, we are still far from general introduction of electric welding in bridge construction.

Along with the failure to fulfill the plan for production and supply of welded span sections, the Ministry of Transportation likewise failed to perform some necessary preparatory measures for the effective implementation of this most important program. In particular, the standard specifications for planning and manufacture of welded spans were not approved, and the training of automatic arc-welding specialists is being only weakly pushed.

Academician Ye. O. Paton, who prepared the standard specifications, has given and continues to give great assistance to the Ministry of Transportation in this respect.

It should be noted that the Ministry of Transportation, and in particular the Central Administration of Roadways, still retain a conservative attitude toward welded bridges, which attitude cannot but affect the headway of the project.

We are little experienced with automatically welded spans. We must rely on specialists having the necessary experience and knowledge, and in particular upon Paton, the most highly qualified specialist in the field. The bridge builders of the Ministry work against the Electric Arc Welding Institute, and repeatedly introduce corrections and fundamental amendments to the standard specifications prepared by the Institute. As a result, the standard specifications submitted in 1946 have not yet been approved.

Glavmostostroy and the Scientific and Technical Council of the Ministry must decide these questions with the least delay. Welded spans must be of the highest quality, and this is possible only by giving careful attention to the technology and method of welding. Control of adherence to requirements can only be realized by highly qualified specialists.

The construction of temporary living and working quarters, of staging, of temporary bridge decks, etc., occupies an important place in terms of expenditure of time, labor force, and materials. The cost of housing and working accommodations alone amounts to 12 percent of the total cost of a bridge.

In 1946, the bridge trains of the Glavmostostroy averaged 11-12 months for one bridge reconstruction job. Building of temporary structures accounts for 25 percent of the time spent in such reconstruction, and expenditure of material and money are correspondingly high. Many builders failed to consider the temporary and seasonal aspects of housing construction in 1946, with the result that many of the structures were more permanent than necessary, since at the end of the bridge job they still had to be torn down.

At present, it has been decided to use stock prefabricated housing, warehouses, workshops, and other buildings. Stock staging and centers are being manufactured. The manufacture of small emergency bridges to be supported on screw jacks is contemplated for the near future.

The realization of these measures will make possible an important reduction in bridge construction or reconstruction time. Material, labor, and capital will be saved. The use of stock metal staging, for instance, will cut the timber needed for putting up a 100-meter span about 80 percent.

It should be noted that the weight of the approved type of stock staging is still too high. The plans for this staging should be reviewed with this in mind. Weight reduction could easily be attained by using tubular-steel cross sections instead of channel beams. Preliminary calculations indicate a weight reduction of 50 percent or more could be achieved in the manufacture of these stock stagings.

The 1947 Glavmostostroy program calls for construction and reconstruction of 225 bridges at a total cost of over 400 million rubles. The Glavmostostroy itself will invest another 80 million rubles in the construction of bridge-building plants. It is understandable that in operations of such large scale, the smallest saving in percent will represent a considerable amount of money.

The necessity for the strictest economy is not, however, appreciated by all builders.

The introduction of cost accounting and material planning in the lowest echelons of construction is one of the basic tasks of the 1947 bridge-building plan.

A large percentage of workers in bridge construction are still not fulfilling their norms. In 1946, this group amounted to 4.5 percent of the workers. The blame for this falls on a number of organizations which have been irresponsible concerning living and working conditions for the workers. In the places where due attention was given this problem, the success speaks for itself. For example, bridge train No 411 (Artemenko, chief) pays a great deal of attention to its workers' needs, and they always surpass their quotas. It received six awards this year, while No 414 (Suslov, chief) received five.

Nearly 5,000 Stakhanovites -- erection and carpentry men -- are now producing 1.5-2 annual quotas each year. Latheman Davydov did 2.5 years work in one. Stonecutter Naumov, until his election to the Supreme Soviet of the RSFSR, was surpassing his quotas 5,400 percent.

Glavmostostroy has grown to be an enormous specialized organization. In the current year it must carry out reconstruction of 18 unclassified (vneklassnaya) bridges totaling 15,715 meters in length, 108 large bridges totaling 21,159 meters, and 99 medium bridges totaling 5,478 meters.

Such a program will not be possible without maximum mechanization of labor, and the most modern technology.

Glavmostostroy plans to introduce a number of improvements in construction of abutment foundations. These improvements will involve the use of long reinforced concrete, metal, timber, and screw piles in connection with thin-walled caissons. For the foundations of small bridges, large prefabricated blocks will be used. The facing (oblitsovka) of the abutments of large and medium bridges will be hinged. The metal girder assembly will be hinged or semihinged. Metal span sections more than 45 meters long will be arc welded. To conserve metal, reinforced-concrete span sections will be used for several large and medium bridges.

According to preliminary calculations made by Glavmostostroy, 1947 construction costs should be lowered 18 million rubles by the above measures. Timber saving will amount to 36,000 cubic meters, and labor expenditure will be decreased by 300,000 man-days.

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